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ON THE LIFE HISTORY OF THE GREAT NAWAB, OR *POLYURA EUDAMIPPUS WEISMANNI* FRITZE OF OKINAWA ISLAND

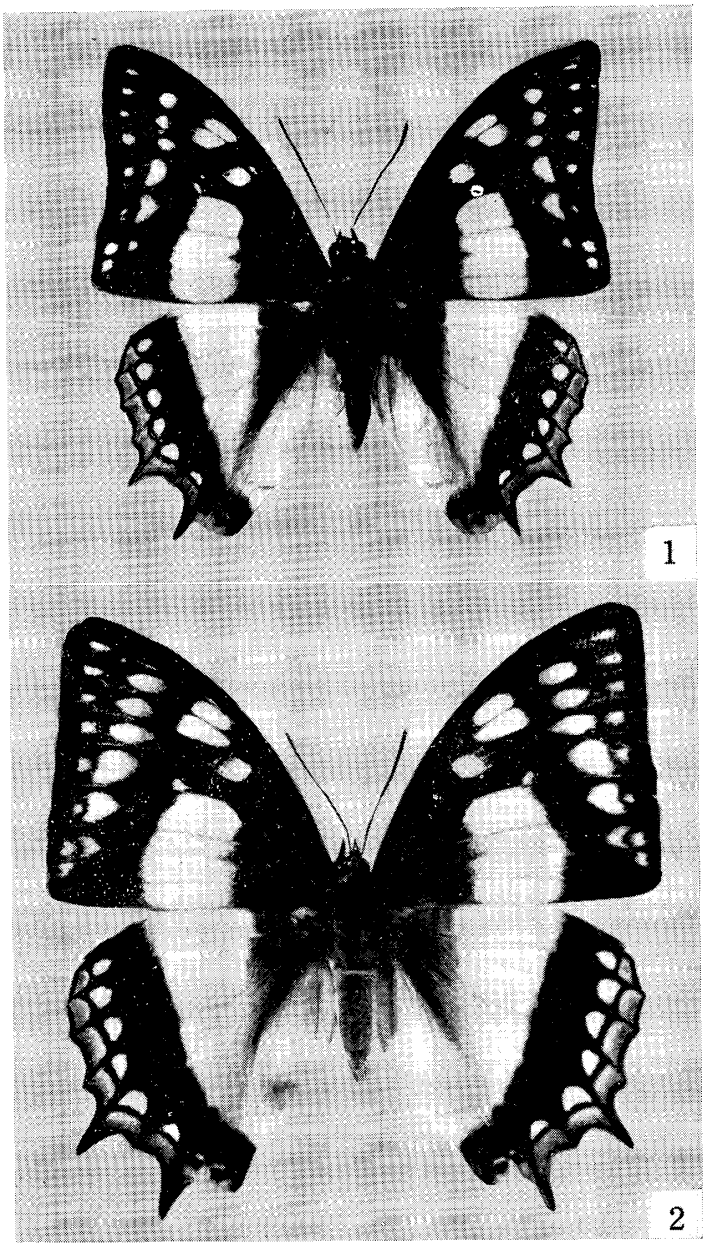
By KAIYA KUBO[1)]

The genus *Polyura*(=*Eriboea*), closely related to *Charaxes*, includes several species found in India and southeast Asia. While *Charaxes* butterflies, with their stronghold in Africa, are extensively distributed from the Iberian Peninsula to Malaya, *Polyura* is essentially an Asian genus.

The range of the Great Nawab, *P. eudamippus*, may be included within a triangle formed with the vertices of Northern India, Singapore and Okinawa. The easternmost subspecies, *P.e. weismanni* FRITZE of the mainland of Okinawa constitutes an isolated population, as it is absent from the rest of the Okinawa Archipelago, although it is distributed throughout Formosa.

This interesting butterfly has been known from Okinawa for more than seventy years, but its early stages have remained undiscovered elsewhere in Asia.

The present author twice visited the island for field research (July——August 1961 and April, 1962), and has been fortunate to discover and follow a greater part of its life history. Thanks to the co-operative efforts of Messrs. SEIJI HIGASHIHIRACHI and MITSUO GOTÔ, both of Okinawa, the author has sufficiently been informed of additional facts and data. In publicizing an outline of the Great Nawab's life history he wishes to express his especial gratitude to them. Thanks are also due to the late Mr. KEI HAYASHI, to whom he has owed parts of the description of the butterfly's early stages, as well as to Mr. TARÔ IWASE, Dr. TAKASHI SHIRÔZU, Messrs. HARUO FUKUDA, AKIRA HARA and TADAHIRO TAKAKURA, who have constantly extended to him advice and assistance in the completion of this report.



Polyura eudamippus weismanni FRITZE
Fig.1 ♂, Fig.2 ♀, (Natural size)

1) 10 Mitake-chô, Shibuya-ku, Tôkyô

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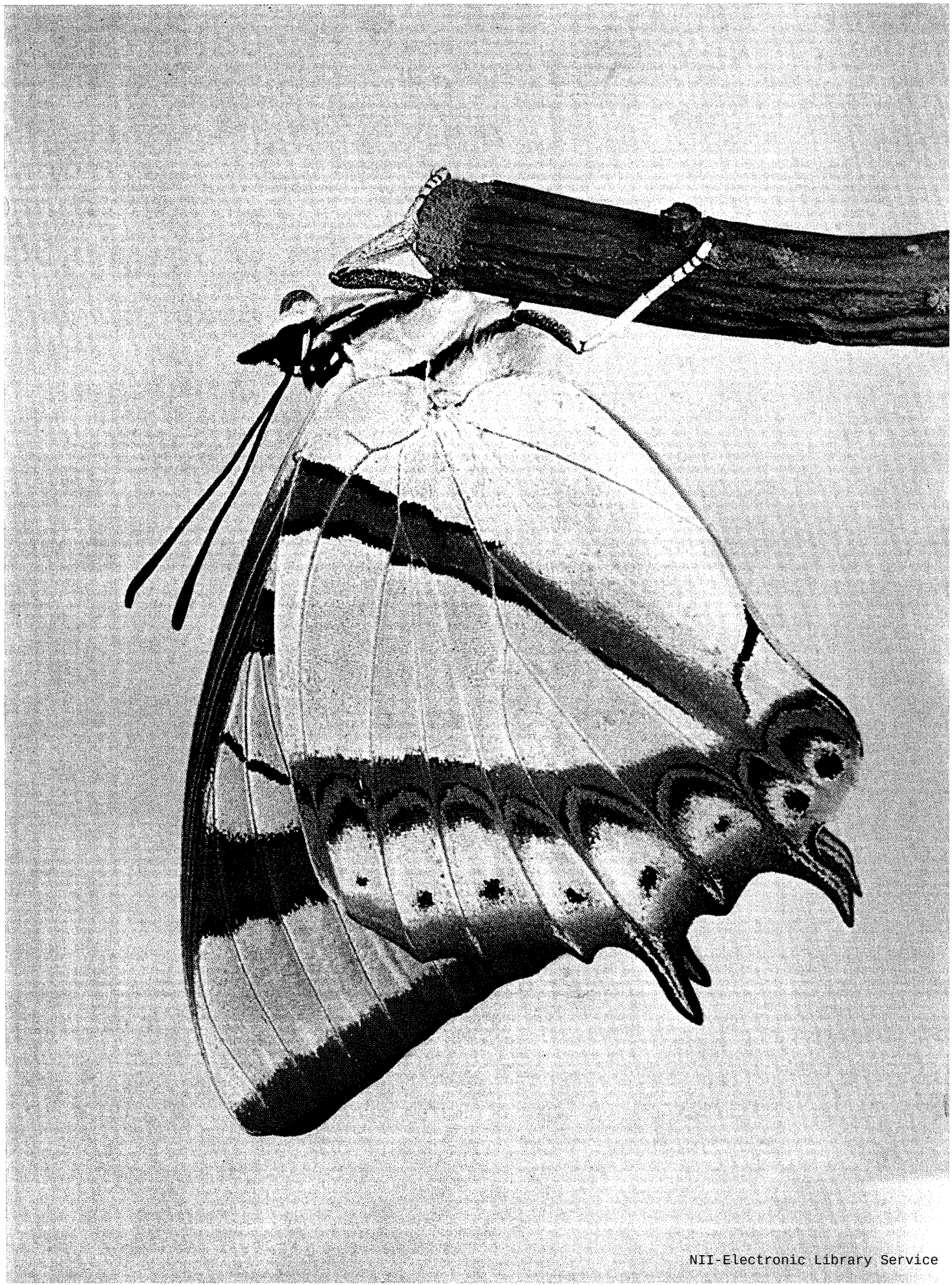

フタオチョウ♀の羽化

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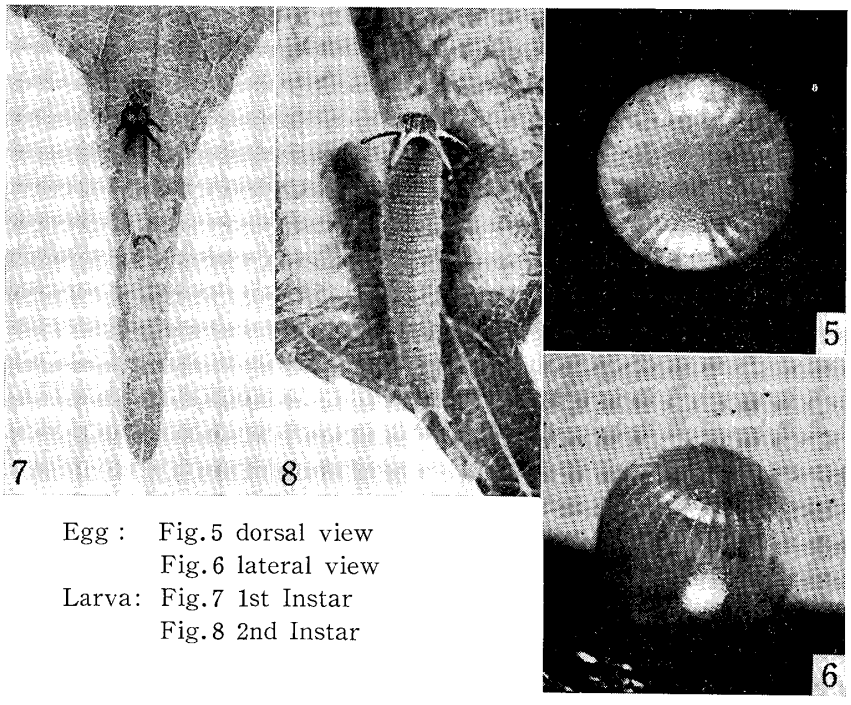
1. Distribution

Polyura eudamippus weismanni FRITZE is found in the main island of Okinawa and nowhere else in the numerous festoon islands of Ryûkyû. Even in Okinawa Island it seems to be restricted to the northern part and it is very local. Past records are from such localities as the Motobu Peninsula (Izumi, Nakijin), Nago Town (Nan-nan-gusuku), Haneji Village (Makiya, Genka, Tanyôdake), Ôgimi Village (Taiho, Nuha, Kijoka, Tagasato) and others. In addition, the author has sighted the butterflies at Kunigami Village (Hiji)and Yabu Village (Katsuyama). This fact encourages efforts to discover new localities. Mr. M. GOTÔ has written to me that the Great Nawab was once seen in the Village of Kin, in the central part of the island. Its occurrence there, however, needs confirmation by rediscovery.

Fig. 3 *Rhamnella franguloides* var. *inaequilatera* (OHWI) HATUSIMA
Fig. 4 *Celtis boninensis* KOIDZ.



Egg : Fig. 5 dorsal view
Fig. 6 lateral view
Larva: Fig. 7 1st Instar
Fig. 8 2nd Instar

2. Occurrence and Habits of the Butterflies

According to the data so far collected, butterflies seem to have been taken chiefly in May and from July to August. The author saw one specimen on as early as the 10th of April (1962) at Hiji, Kunigami Village. It was flying over the crowns of huge trees. Nine days later he was so fortunate as to see and

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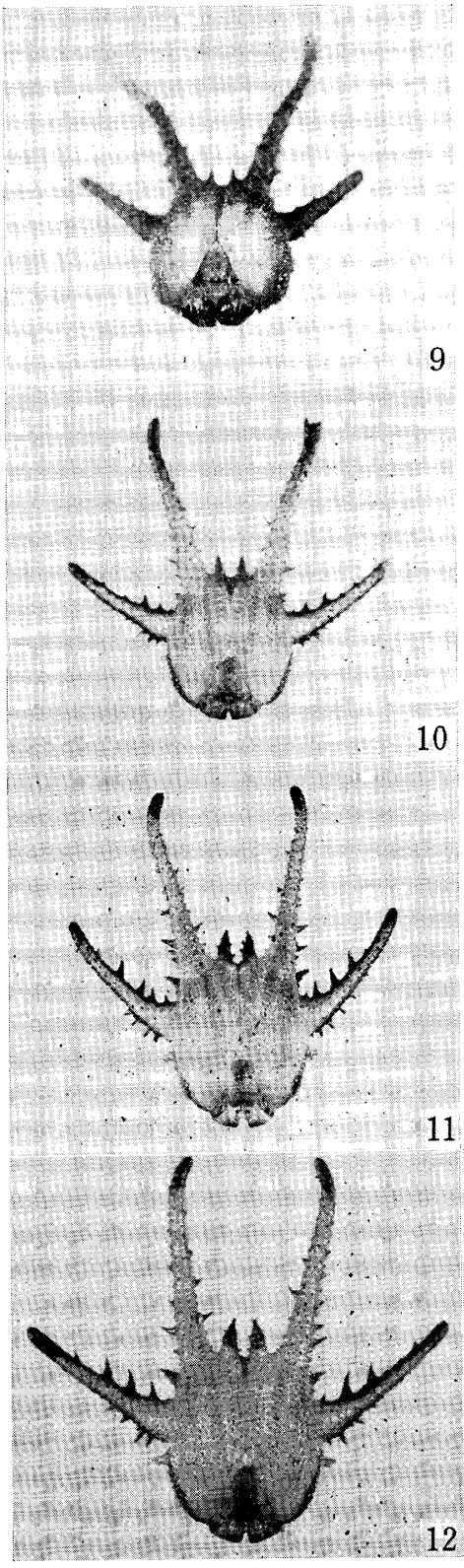

Head of larva: Fig. 9 1st Instar Fig. 10 2nd Instar
Fig. 11 3rd Instar Fig. 12 4th Instar Fig. 13 5th Instar

take a female butterfly at Katsuyama, Yabu Village. Judging from the existence of fully grown larvae in September and October and occasional discoveries of pupae in winter, it can be said that the butterlfy is at least double-brooded: the first brood appearing from the second week of April to mid-May, and the second, from mid-July to late in August. However, latest records suggest the occurrence of partial third brood butterflies between September and October, but they may be rare.

The butterflies, probably males, like to fly over huge trees as if to patrol. They seem to have a predilection for special leaves to sit on, and between patrols they are settled there. Apparently they territorialize the habitat, since they start out from their favourite "roosts" to attack other butterflies trespassing. Their way of flight is very much like that of the Small Purple Emperor (*Apatura ilia*, which in absent in Okinawa), but the pale whitish yellow of their wings gives an unmistakable unique impression.

The laying habit of the female butterfly is not unlike that of *Apatura* and *Limenitis*; her slow fluttering flight around the foodplant presents a sharp contrast to her usually rapid and powerful flight. Upon laying an egg, she flies off but soon alights to resume oviposition.

Adults of both sexes are fond of overripe and rotten fruit, especially pineapples, but they may also be seen visiting tree sap.

3. Foodplants

Some *Polyura* species have been known to feed on Leguminosae: for example, the Common Nawab, *P. athamas*, and *P. hebe*, live on *Albizzia* (silk-tree), *Adenanthera*, *Acacia* and others in Malaya (R. Morrell, Common Malayan Butterflies, 1960). In fact, *Albizzia* is given as the foodplant of the Great Nawab in Lee Chuan Lung's

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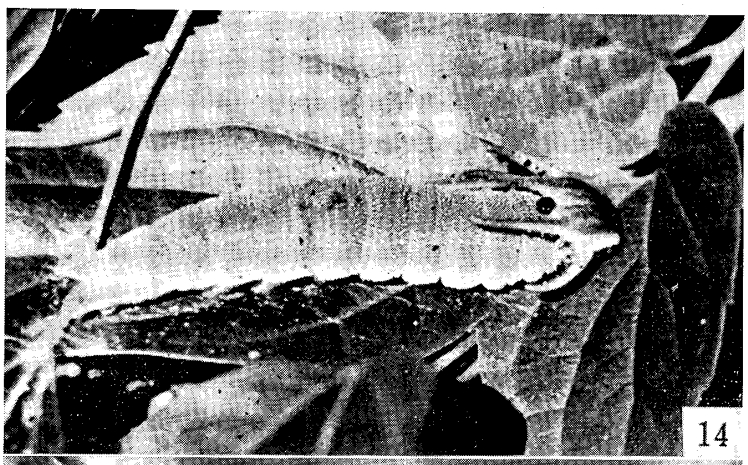


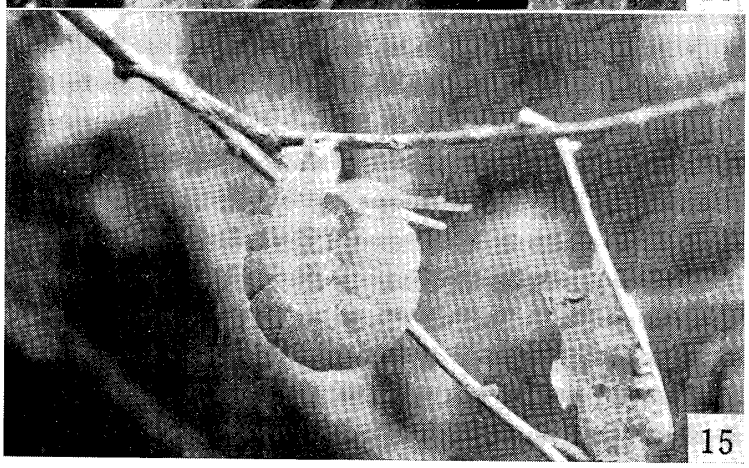
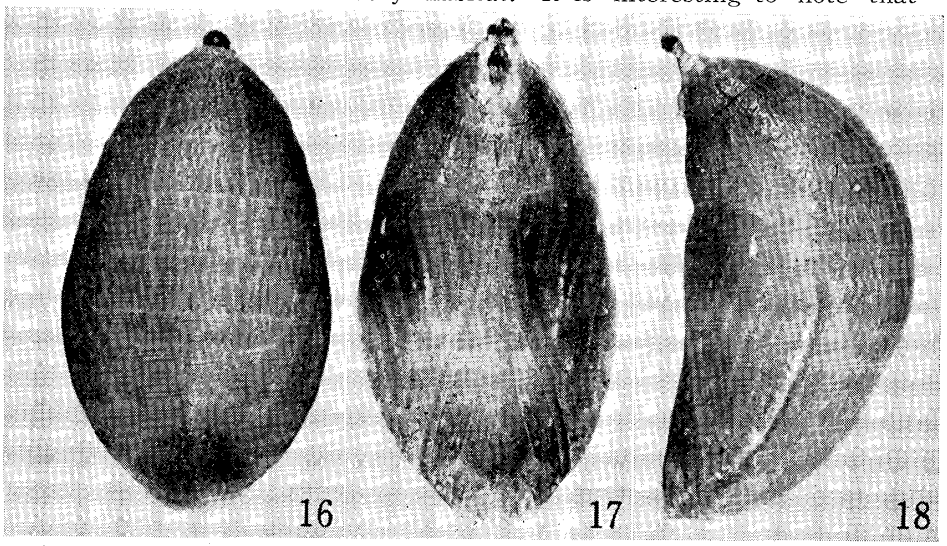


Fig. 14 5th instar larva Fig. 15 prepupa

Hu Dieh (=Butterflies, 1958). At first, therefore, the present author looked in vain for silktrees and acacias in the habitats of the butterfly.

However, on the 27th of July, 1961, he unexpectedly found at Nan-nan-gusuku, Nago Town, two full-grown larvae feeding, and also an egg, on a nettle tree, *Celtis boninensis* KOIDZ. (Ulmaceae). Incidentally, the same tree is the foodplant of *Hestina assimilis* in Amami Island. Then, two days later, he witnessed a female slowly fluttering about at Izumi, Motobu Town. Apparently she was eager to lay her eggs, but no nettle trees were found nearby. Finally she settled on a leaf of a tree and laid an egg. Then the author could collect as many as nine eggs on the same tree, which was later identified as a buckthorn tree, *Rhamnella franguloides* var. *inaequilatera* (OHWI) HATUSIMA (Rhamnaceae).

In summarizing the result of later field observations, it can be said that this broad-leaved buckthorn tree is much preferred to the nettle tree in almost every habitat. It is interesting to note that these buckthorn trees are distributed rather locally in the hilly northern part of Okinawa Island, but they are extremely rare elsewhere in the island. This may well account for the almost exclusive occurrence of the butterfly in the northern localities.



Pupa: Fig. 16 dorsal view Fig. 17 ventral view
Fig. 18 lateral view

4. Egg

Eggs are usually laid singly on the upper sur-

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face of the leaves of the foodplants. Exceptionally, however, the underside is selected by the laying butterfly. Leaves with two to eight eggs laid at a time were also observed.

The late Mr. HAYASHI describes the egg as follows (hereafter asterisks *...* indicate quotation from his MSS):——

*Egg large, pale yellow in colour, with a flat top but spherical elsewhere, giving an impression of an inverted dome.

Approximate measurements of an egg:

maximum diameter.....1.8 mm

height.....1.6 mm

diameter of the top disk.....1.3 mm

Thirty-two or thirty-three ridges start from the inside of the periphery of the top disk and run perpendicularly down, but they are only conspicuous outside a cocentric circle (its diameter: about $^2/_3$ that of the disk) on the disk, and just below the margin of the disk. Elsewhere, that is, inside the cocentric circle on top, and most of the spherical part of the egg, are minutely reticulated. Eggshell transparent and very thin.*

The pale yellow egg, if inverted, may be said to resemble some *Papilios*' eggs, but is larger and glossier. The egg stage lasts three to five days, according to the temperature. When the hatching time draws near, the brown cordate mask of the larva, which lies sidewise in a coil, begins to show itself under a lateral part of the eggshell.

5. Larva

In hatching, the larva eats along the rim of the eggshell so that the flat disk on top is made into a lid, from under which it crawls out. After a short rest, it consumes part or most of the eggshell.

The most outstanding feature of this species is that the head of the larva is provided with conspicuous projections or horns since as early as the first instar. This characteristic, along with the number of the horns (four), is not shared by any other butterflies' larvae found and known in Japan. Certainly many caterpillars, especially those belonging to Apaturinae and Lethinae, are horned, but they are born with a more or less smooth skull, and only after their first moult are they provided with a pair of long horns.

In about 30 seconds after the larva has crawled out of the eggshell, the horns, contracted before extrication, are deflated and then hardened, as is generally seen after an ecdysis of a "horned" larva (see photo). The newly hatched larva is pale yellow in colour, but it turns light green soon after it begins feeding on the leaf. Only the four horns on the head and the two caudal prominences are blackish brown. The mask of the young larva is roundish, and mostly pale brown except in the marginal and central areas.

The newly born larva is 6 to 7 mm long. The length of the two inner horns is about 2 mm, while it is about 2.3 mm from one outer horn to the other (thus, far outmeasuring the scope of the eggshell). The horns are more or less straight, as shown in the figure but the inner ones are slightly curved and they are about 2 mm apart at their extremities.

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The larva, in its first and second instars, spins a pad of silk near the tip of the leaf on which to sit, just as do the larvae of Apaturinae, e. g. *Hestina japonica*. When at rest, it often sits with the body bent to the right or the left, forming a crescent. Sometimes it rests with the anterior half of the body straightened and raised.

When the newly hatched larva is about a week old it moults. The second instar larva is also green, but now nowhere brown or dark brown, as the horns, the rim of the mask and the caudal projections become yellow. A yellow subspiracular line becomes clear on each side of the body, and the dorsal skin grows more and more conspicuously granulous. The second instar lasts also about a week. Immediately after its first moult the larva is about 8 mm long, and at the end of the second stage it is 14 mm long and 2 mm thick. From about this time onwards the larva usually rests with the anterior half of the body raised rather high. The inner horns, now yellow, are about 3 mm apart at the ends. Both pairs of the horns are about 5 mm in length. The mandibles, measured together, are 1 mm across.

Whenever the larva is nearing a mouit, the "nape" becomes awkwardly swollen and turns pale yellow. Under the thoracical skin, then, there can be observed short rosy lines running across, which will later develop into horns. How the skulls change is shown in the figures.

The third instar larva is about 19 mm immediately after the moult. At this stage the growth is very rapid, becoming fully fed in about four days. Then the larva is24 mm long and 4 mm thick at the prothorax, which is the widest at this stage.

After the third moult it is 26 mm long and 6 mm thick, but towards the end of this instar, which lasts about nine days, it grows rather rapidly, measuring ultimately 34 mm long.

The fifth (=last) instar larva only measures 38 mm in length just after the moult. When disturbed, it shrinks by no less than 10 mm and raises its caudal segments.

In the case of most Apaturinae larvae, the final larval stage usually lasts from ten days to a fortnight. With the Great Nawab, however, the fifth instar extends over an exceptionally long period. It took just one month for a larva bred in captivity by the author in the autumn of 1962, in Tôkyô, to be fully fed. Mr. HIGASHIHIRACHI's local observation of a wild larva has resulted in a similar conclusion. However, both these examples are of autumn larvae that pupated to hibernate, and in all probability the early summer larvae will be fully fed in a shorter period than one month, thanks to warmer temperatures and fresher leaves of the foodplants.

The growth of the last instar larva is rather slow, but steady. The adult larva bred in Tôkyô measured 63 mm when it stopped feeding. Mr. GOTÔ of Okinawa informed me that he had observed a huge (presumably a female) caterpillar reaching 68 mm in length.

Here again, the author wishes to quote the late Mr. HAYASHI's description of a fifth instar larva, based on a rather young specimen taken in Okinawa, then measuring about 50 mm in length.

*Head. The mask is longer than broad, more so than in other horned nymphalid larvae, e. g. *Apatura*, *Dichorragia* or *Cyrestis*, as well as more elliptical. It is 6.5~7.5 mm across. The skull is very flat and crowned with two pairs of long horns. The outer pair are convex outwards, measuring about 8 mm long. The inner pair, about 10 mm in length and more or less straight, start near the vertex. They slightly curve inwards. The horns are not knobbed or clubbed in their extremities but have smooth, round ends. The coarsely surfaced horns are provided with some

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conspicuous serratures in addition to many minor projections. There are also three lateral serrate projections lying caudad on each side of the skull. On the vertex near the epicranial stem there are two small conical horns. They lie close to each other below and between the inner horns. Their points slightly turn inwards, thus giving an impression of an opened bill. The mask is densely covered with minute cupola-form points which emit fine white hairs.

Colouring of the Head. The ground colour of the mask is pale green. The central part of the "face" have three pairs of longitudinal (roughly parallel with the epicranial stem) green bands, appreciably darker than the ground colour. The periphery of the flat skull and the outer side of the four major horns are yellowish green. The serratures on the horns are black-pointed; the bill-like vertical horns are glossy black, which look like false mandibles.

Body. The thoracical and abdominal segments are cylindrical but fairly flat, extended sideways along the basai lines. The body is thickest in thoracical and a few immediately following abdominal segments, and gradually tapers towards the tail near which it becomes flat. The dorsum of the tenth abdominal segment froms a hard rectangular subanal plate, ending in two short but broad projections which are wide apart. The skin of the body is finely granulated with small hemi-spherical or blunt conical points. They are rather large and conspicuous along the basal lines; ventrally, however, they are smaller. These small points are each provided with a short hair.

Colouring of the Body. Dorsally green, with dense yellow points. The basal parts of the segments assume a rich yellow hue because of the dense, larger points, with the result that tha larva has a thick yellow fringe that reaches as far as the two caudal projections. Ventrally, the larva is a paler green.

Peculiarities of the larva. Whereas many other horned larvae of Nymphalidae, including Apaturinae, rest on a layer of silk spun on the leaf with their heads turned downwards, the larva of the Great Nawab, sitting as it does on a similar pad on the leaf, rests with the head turned upwards, so that the horns point to the rear.

The larva moults four times before it is fully grown, and it looks more or less similar in shape throughout its larval stages. This is quite an exception among the nymphalid species of long-horned larvae, which are born round-headed. The newly hatched larva of this butterfly is already provided with four prominent horns which are similar, if not in colour, to those of the elder larvae.*

6. Pupa

When fully fed, the adult larva usually leaves the twig on which it has been living and, after doing much wandering, finds a suitable pupating spot. According to the author's own experience of rearing as well as to the local observations carried out by Messrs. Gotô and Higashihirachi, the larva unexceptionally selects a thin twig for pupation, and never the underside of a leaf, as in Apaturinae. The wandering larvae, especially those going to winter as a pupa, may even leave the foodplants and pupate somewhere else. Evergreen trees such as *Piper kadzura* Ohwi (Piperaceae) and *Murraya paniculata* Jack (Rutaceae) growing in the neighbourhood of foodplants are sometimes found to house or to have housed many a pupa.

The prepupal stage lasts for about five days (in autumn). The prepupa, hanging by the tail from a thick silk pad, looks exactly like that of the Common Evening Brown, *Melanitis leda* or those of

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some other satyrid species. Viewed from sideways, the prepupa is in the form of a thick inverted question mark, as against the prepupae of Apaturinae, which remain straight until ecdysis.

Neither the shape of the pupa has any likelihood in Apaturinae. It is round and smooth but not glossy, without spines, projection or spots. It is translucent emerald green in colour, and not white-powdered as in Apaturinae. Some individuals have thin yellow lines but with others they are almost inconspicuous. They are subdorsal and supraspiracular lines, and a line on the dorsum of each wing case. The pupa measures 30~35 mm long.

The emptied pupa cases remain pale yellow or pale malachite green for a long time, again unlike those of *Apatura* and *Hestina*, which are invariably white and have a bleached look as soon as the butterflies hatch.

7. Hibernation

That the butterfly is first seen early in April and last seen in October is sufficiently suggestive of its hibernation in the pupal stage. Furthermore, fully grown larvae have been found late in autumn, as well as pupae in winter. One such example is a pupa taken in the wild by Mr. HIGASHIHIRACHI in Okinawa in December, 1961. It was sent to Tôkyô, and kept indoors. On June 1, 1962, a famale butterfly successfully emerged from it (see photo).

Since the Okinawa range of the Great Nawab is free from frost, the possibility cannot altogether be discarded that there might be some larvae which overwinter, as in *Hestina*. Whether this possibility is excluded or not should be clarified through the local entomologists' observations.

8. Natural Enemy

The author had noticed since as early as the first discovery of eggs that many of them had developed internal abnormalities. Naturally, none of such eggs produced a larva. It is possible that some of them had been parasitized, for he obtained tiny wasps from eggs collected later in Okinawa and sent to him. These insects were then forwarded to the Entomological Laboratory, Faculty of Agriculture, Kyûshû University. Dr. Keizô Yasumatsu, President of the Entomological Society of Japan, was so kind as to describe them as belonging to a new species, *Telenomus (Aholcus) kuboi* (Hym., Scelionidae). Those interested should refer to the Kontyû, Vol. 30, No. 4, pp. 260—261 (1962). So far, no other natural enemies have been discovered.

9. Conclusion.

Thus the author has been able to clarify, if not fully, the life history of the Great Nawab in Okinawa. Part of the materials and data collected by himself were offered for illustration in "Early Stages of Japanese Butterflies in Colour (by SHIRŌZU and HARA, 1962)," Vol. II, with which the readers of this paper are no doubt already familiar.

Now the author recollects, almost regretfully, his earlier discoveries, the publication of which only proved to be a guide to overcollection in earlier stages of uncommon species, whose adult butterflies are difficult to collect. Such was the case with eggs of *Chrysozephyrus ataxus yakushimaensis*, eggs and larvae of *Hestina assimilis*. He should be held responsible if this superb and unique butterfly that may well represent Okinawa, again, should be menaced with extinction on account

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of the hunting out of helpless larvae and pupae, as the adults are by no means easy to collect. In conclusion, the author wishes every entomologist inhabiting or visiting the mainland of Okinawa to look further into the life of this beautiful butterfly, as well as to use his discretion in collecting examples of this species in its all stages.

要 約

筆者は，フタオチョウ（沖縄亜種）*Polyura eudamippus weismanni* Fritze の生活史に関する調査に当り幸いにもその大半を知る事が出来たのでここに報告する．

1 **分布**：表記の亜種は琉球列島の内，沖縄本島のみから知られ，同島北部一帯に局地的に分布する．

2 **成虫の出現期**：今回の観察では第1化は4月中旬から5月中旬，第2化は7月中旬から8月下旬に見られ，稀に9月頃第3化のものが見られる．

3 **食草** ニレ科のリュウキュウエノキ（クワノハエノキ）及びクロウメモドキ科のヤエヤマネコノチチが食草として確認出来た．野外では主として後者を好むようである．

4 **卵** 卵は食葉の表面に1個づつ産付され，稀に裏面にも見られる．形態大型，淡黄色で側面から低面にかけては球型で，上面は扁平であたかもマンジュウ型の卵が倒立したかの如く見える．

最大径：約1.8mm　高さ：約1.6mm　上面平坦部の径は約1.3mm

平坦部の外周から側面にかけて32～33本の細い隆起条が有るが，上面では径の約1/3，側面でも，肩に当る部分にだけ認められる．卵殻は無色で極めて薄く，産付当時は淡黄色であるが卵期3～5日で孵化直前になると幼虫の頭部が茶色に透視出来る様になる．

5 **幼虫** 本種にのみ見られる特異の点として，卵から孵化した当時から頭部に2対の突起を有する事が挙げられる．1令幼虫の頭部は黒褐色であるが，2令以後は黄緑色となる．若令幼虫は摂食時以外は近縁のゴマダラチョウ等の様に食葉の先端部に吐糸し，静止する．

次に記したものは1962年9～10月に飼育した際のメモである．秋期の為か意外に終令期間が長くかかつている．

卵期3～5日，1令　7日，2令　7日，3令　4日，4令　9日，5令　30日

幼虫の他の特徴としては背面に突起を生ぜず，体色も1令から終令迄，同じ緑色を呈する事である．

胴部は，やや扁平で尾部に至り次第に細まり，尾部には1対の2叉状突起を有する．老熟幼虫の大きいものは体長約70mmに達するものもある．頭部の形態については，近縁のコムラサキ，ゴマダラチョウ等の場合は顔を下に向け‘突起の部分が直立する格好になるが‘本種では常に突起を後に倒し，口器は，前方に向ける点が異る．

6 **蛹** 前蛹期は約5日で，形態的には一見，ウスイロコノマチョウのそれに似る．

蛹にも特徴が有り，全体に丸味を持ち，頭部や背面にも全く突起がない．蛹化後，成虫化の起こる迄は透き通る様な鮮緑色で，僅かに前翅後縁部に淡黄線を布き，腹部後方の亜背線及び気門上に淡黄白色の条線を表わす．体長約30mm，大きいものでは約35mmに達する．又，蛹越冬である事も確認出来た．第1図版（カラー）はその中の1例であり，翌年6月に至り羽化したものである．

7 **天敵** 目下のところ天敵としては下記のものが知られる．本種の卵寄生蜂について九州大学農学部昆虫学教室で調べて頂いた結果，「昆虫」第30巻第4号誌上に安松京三博士の手により新種として記載された．クロタマゴバチ科の一種で学名を *Telenomus* (*Aholcus*) *kuboi* と云う．

終りに本稿の完成直前に故人となられた林慶氏を始め，磐瀬太郎，白水隆，福田晴夫の諸氏には沢山の御助言を頂いた．又，本文の英訳は高倉忠博氏に，写真は成虫，幼虫の頭部，蛹等大半を原章氏に，ペン画は中島暉躬氏に御願いした．現地に於ける東平地清二，後藤光男の両氏の御協力も忘れる事の出来ないものが多い．末文乍ら報文作成に御協力頂いた諸氏に厚く御礼申し上げる次第である．

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